LUBRICATION

A Technical Publication Devoted to the Selection and Use of Lubricants

Published by

The Texas Company, 135 East 42nd Street, New York City

Vol. XXIV January, 1938 No. 1

How Elevator Developments Have Paralleled Petroleum

MANY engineering developments which have added to our comforts and furthered the progress of our civilization have originated contingent with research in other fields. Mechanical devices of necessity require lubrication: when not too complex or involving of personal hazards, they have been able to use the lubricants available at the time of their development. Prior to the latter part of the last century when petroleum was definitely proved to be the basis of lubrication, one had to be satisfied with a variety of animal and vegetable oils, which might be entirely too unstable to assure of proper protection of the working mechanisms. Petroleum, however, changed all this. Petroleum lubricants were soon found to be more resistant to oxidation, capable of withstanding changes in temperature, more dependable and able to be prepared over far wider viscosity ranges.

At about the same time developments in elevator design had been perfected to such an extent as to require lubricants of these very characteristics in the interest of public safety. To be sure Otis antedated the "Drake well" by some two years when he installed his first passenger elevator in 1857; the next several years, however, showed no marked reception of the products of either industry, until the early seventies when hydraulic elevators were introduced and installed in office buildings, and the elements of refinery procedure were established by petroleum chemists.

From there on the developments in both industries paralleled each other. As the elevator industry discarded hemp rope in favor of wire rope the petroleum industry met the situation with lubricants suited to protection of the strands against rust, corrosion and wear; when worm reduction gears were perfected, compounded gear lubricants were made available; when guide rail lubrication concerned the elevator industry lubricating engineers cooperated in the study, all to the ultimate benefit of the passengers, their safety, their comfort and the protection of their clothing. For second to the discomfort of climbing stairs was the knowledge that inferior lubricants might drip through the top of the car to spoil a hat or ruin a costly gown or coat.

These requirements of safety, comfort and cleanliness, coupled with the load conditions which developed as buildings of greater height were constructed, imposed a definite obligation on the elevator designer, the maintenance engineer and the lubrication specialist. It called for their joint consideration of elevator lubrication as one of their primary problems. That such a procedure would pay dividends was emphasized by the fact that effective lubrication would lengthen the life of materials.

In other respects it must be realized that few other types of machinery involving the same mechanical principles operate under such severe conditions where starting and stopping under load is continuous. In the geared trac-

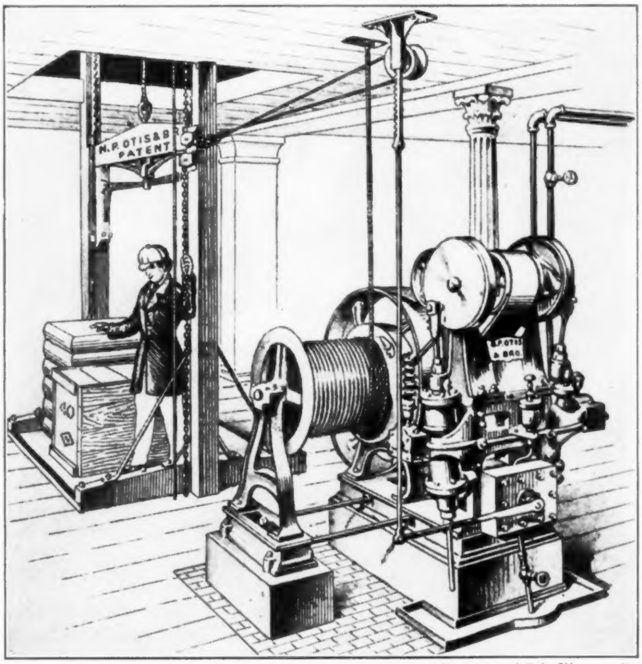
tion elevator where the worm has to exert a starting torque about three times the normal, load conditions of this nature may readily be so severe as to cause some lubricants to be squeezed entirely out from between the contact parts they should be protecting.

TRANSITION IN DESIGN

Through the early designs of Otis, Tufts and Baxter there was a transition from steam to hydraulic power and ultimately to electricity, the latter predominating today. Hydraulic power supplanted steam because it enabled smoother, quieter and more economical car operation. Electric power gained its popularity, with the development of the six-point control, through its adaptability to higher lifts than hydraulic power, and because car control, braking and floor levelling could be carried out more easily.

From these basic ideas six types of passenger and freight elevators developed, to remain in more or less common use today, viz.:

The Electric Traction (gearless)
The Electric Traction (geared)
The Electric Drum
The Hydraulic Plunger
The Horizontal Hydraulic Cylinder (rope geared)
The Vertical Hydraulic Cylinder (rope geared).



Courtesy of Otis Elevator Co.

Fig. 1—A very early steam freight elevator showing the old style ratchet safety device on the platform to prevent its falling in case the single hoisting rope should break.

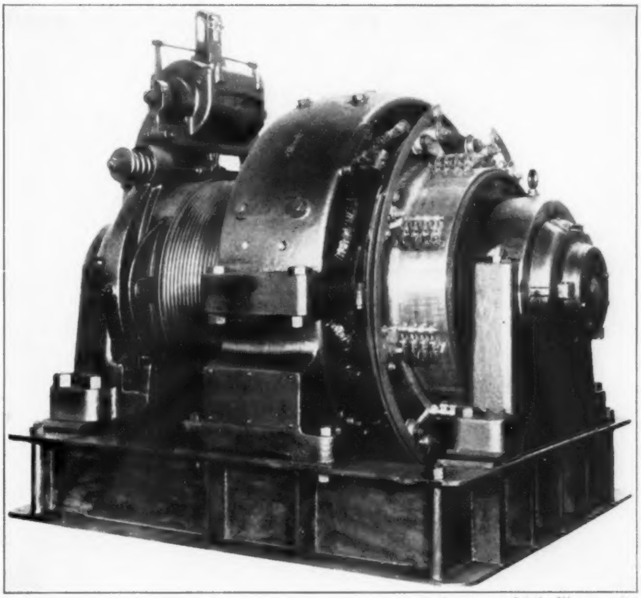
The electric traction elevator is of most concern to the lubricating engineer in view of its wide general use, high lift capabilities, its operating speeds and the variety of wire rope, gear and bearing mechanisms required for its operation. He is not so much concerned with the various types of hydraulic elevators, for, while there are still such elevators in service, their application to new construction for passenger service has been virtually discarded; although they are still practicable for short rise freight handling. The chief objection, besides speed limitation, is the low efficiency obtained due to the fact that any hydraulic elevator operates constantly under full load conditions, regardless of the actual live load being carried. It is limited also as to travel by the excessive cost required to sink deep casings for the plunger cylinders.

It was not until the latter part of the nineteenth century, however, that the electric elevator became a practicable mechanism. Until then, as stated, steam and hydraulic power had prevailed. In the application of such power the usual design provided for either lifting or hoisting, using multiple sheaves that enabled lifting by wire rope, or a long rod or pillar to push the elevator cage up from below.

Lubrication in devices of this type was often neglected until comparatively high lifts became necessary, thereby imposing more severe duty upon the pumps which had to develop the water pressure. Furthermore, it was always necessary to run the plunger through a cup leather or some type of packing which maintained the seal at the cylinder. Obviously this friction had to be reduced, hence the development of leather treating compounds and the use of soluble oils in the water supply.

Cost and Space Important

First cost as well as space available for the installation, plays an important part in elevator construction. These two factors have both contributed to decrease the popularity of the hydraulic plunger elevator for passenger and freight service. It can be appreciated that the cost of sinking a cylinder as many as thirty stories into the ground would be relatively enormous if the sub-strata should contain rock layers, as are prevalent under so many of our large cities. Then again, since the operating mechanism for such an elevator is usually re-



Courtesy of Otis Elevator Co.

Fig. 2—A modern gearless traction machine. This is the size equipment used for the new double decked elevators.

quired to be in the basement, we can realize that the high and low pressure water tanks, the operating valves, and the pumping equipment would also take up considerable valuable space. Compared with the modern electric traction elevator where the operating mechanism is generally installed above the hoistway, the space required would be on a ratio of about five to one.

Electric Elevator Design

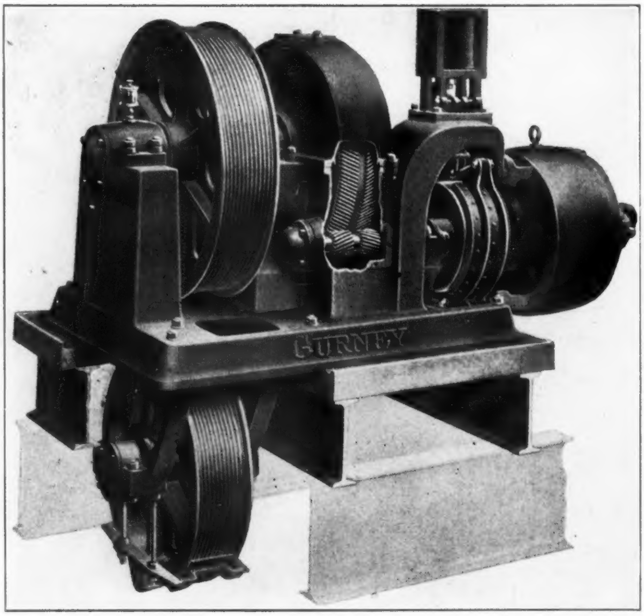
Of the electric elevators, in turn, the drum type is limited to medium lifts on account of the necessary width and diameter of the drums on which the ropes or cables wind. The geared electric traction type is universally used for speeds up to about 400 feet per minute, and short lifts. The gearless traction type is used almost entirely for higher speeds and the longer lifts prevalent in present day office construction; it is the most modern elevator in service today. It has far exceeded the speed ideals of its sponsors, just as the modern office building has exceeded the earlier "skyscraper." The range of lifting capacities and minimum and maximum speeds of a gearless traction elevator will depend on the roping ratio. Such an elevator consists essentially of the car, a counterweight, and a slow speed motor which is rigidly connected to a traction or driving sheave. The ropes attached at one end to the car pass over the driving (and such secondary, guide or deflector) sheaves as are installed, and are made fast at the other end to a counterweight. If the car or counterweight exceed the limit of travel and rest on the buffers and the ropes tend to slacken, the tractive effort is reduced and this prevents either the car or counterweight from being carried into the overhead work, as would be the case with drum machines if the limit switches should not work. In very high lift elevators the effectiveness of this safety feature will be decreased on account of the dead weight of the ropes producing sufficient traction to cause overtravel which might be of considerable danger.

Principles of the Geared Traction Elevator

The use of worm or herringbone reduction gears offers an advantage wherein initial cost may be a factor due to the possibility of using a cheaper high speed motor. In the geared traction elevator the worm or pinion is rigidly

Courtesy of The Gurney Elevator Co.

Fig. 3—The Gurney gearless elevator machine. A unique provision for automatic lubrication of the bearings is a special disc oiler which continually circulates oil to the bearings while the machine is in motion. Likewise, there is provision for continual return of oil to the base. An oil level indicator and cap on each bearing enable observation of the oil level and disc action.



Courtesy of The Gurney Elevator Co.

Fig. 4—A Gurney type traction machine. This was one of the transitions in gear design considered about 25 years ago in the development of high speed passenger elevators. Note the herringbone gears (in cutaway) and oil cup on the bearing.

connected to the driving motor shaft, and located sometimes above but usually below the gear. The entire unit is generally built enclosed in an oil tight casing. End thrust may be taken by an arrangement of tandem gears meshing with each other and with right- and left-hand worms on the same shaft. With single worms and gears thrust exerted by the worm is taken up by either a disc and button thrust bearing on each end, or a single or double acting roller or ball-thrust bearing. In modern construction, the double acting thrust bearing is located at the outer end of the worm shaft, where thrust in either direction is taken up.

This type of elevator will have a lifting capacity from 1,000 to 10,000 lbs., and a speed ranging from 100 to 400 feet per minute. The motor drive may be designed to use either direct or alternating current. While it possesses the advantage of lower first cost, it may involve:

Difficulty in obtaining smooth action and

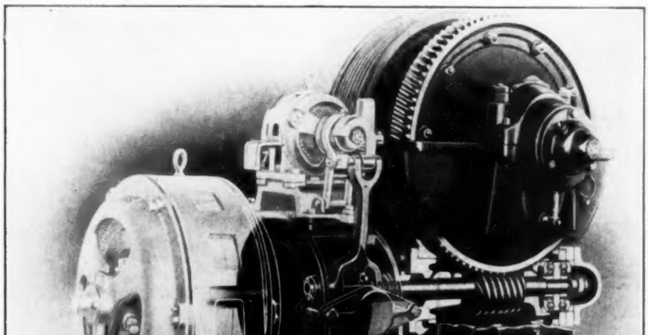
The necessity for care in selection and use of gear lubricants.

The Electric Drum Elevator

This type of elevator, which has been almost entirely superseded by the geared traction machine, was designed for short or medium lifts; it had its hoists mounted either at the top of the shaft or in the basement; the former having the advantage that less rope was needed. Furthermore, they were either single or tandem-geared. In the tandem-geared machine the motor drove a shaft which carried a right- and left-hand worm. These worms meshed with the gears which also meshed with each other. Thus end thrust on the worm shaft was eliminated. The drum was bolted rigidly to one gear; the car being balanced by a counterweight attached to cables fastened to the drum on the opposite side from the hoisting rope. The travel of the car was maintained within the safety limits by automatic limit stops attached to the drum.

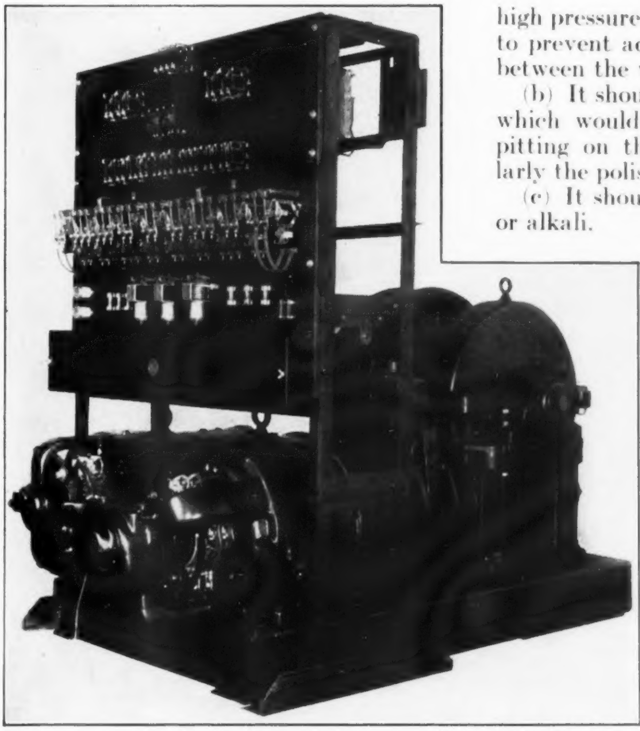
LUBRICATION PROCEDURE

In studying the lubrication of electric elevators thorough knowledge of the design and function of the hoisting mechanism is necessary, in order that intelligent selection of lubricants can be made in accordance with load and speed conditions. The subject can be broadly subdivided into the treatment of electric traction gearless machines, traction geared machines, and drum type elevators. The essential differences will be in the hoisting mechanism. In the gearless type of traction elevator, the motor bearings and sheave bearings are the principal features. Construction will determine manner of lubrication.



Courtesy of Otis Elevator Co.

Fig. 5—Phantom view of drive of an electric driven type of elevator showing in detail the relative positions of worm and gear, and the essential bearings.



Courtesy of Otis Elevator Co.

Fig. 6—The latest improvement in machines for operation on Alternating Current. An individual motor generator set provides current for the elevator motor. This supersedes the two-speed A. C. equipment.

With straight collar type bearings built for chain or ring oilers, the problem is simply that of keeping the oil wells properly filled with a good grade of engine oil, having a viscosity of about 300 seconds Saybolt Universal at 100 degrees Fahr. On the other hand, certain types of machines that involve ball or roller bearings require that the bearing housings be charged with a lubricant specially prepared to meet the load conditions, prevent corrosion, and resistant to breakdown and oxidation. Though there is relatively no sliding contact in such a bearing, the pressure at the points of contact is extremely high.

Worm Gearing

The lubrication requirements of worm gears in a drum type or geared traction elevator, or an escalator, present probably the most important and exacting condition in the entire industry. A suitable lubricant for this purpose should possess certain qualities that do not usually pertain to other oils, viz.:

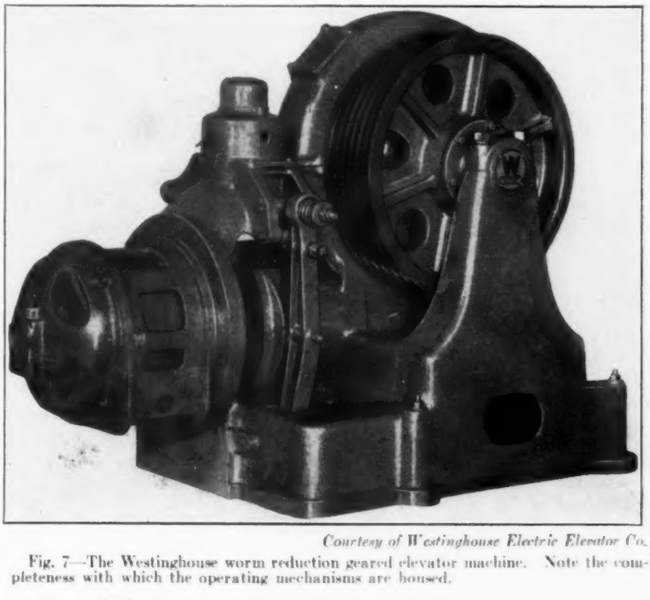
(a) It should be of sufficient body to withstand the excessively high pressure at the points of tooth contact, thereby to prevent actual metal-to-metal friction occurring between the worm and gear.

(b) It should be entirely free from acids or alkalis which would tend to cause a certain amount of pitting on the metallic surfaces covered, particularly the polished steel roller or ball thrust bearings.

(c) It should not be affected by heat, water, acid or alkali.

(d) It should have as low a pour test as possible, in order that it may be used in colder climates without abnormal congealment or excessive power consumption on first starting under very cold conditions.

Opinions of authorities on worm gear construction, operation and lubrication, differ as to the most suitable type of lubricant to meet the above requirements. Some contend that the oil should be a pure mineral product with no animal or vegetable oils compounded therewith; the objection being that the latter may have a tendency to break down, gum and clog the roller or ball thrust bearings under the excessive pressures and temperatures which prevail. For the same reason, these authorities urge that fillers such as graphite, etc., should not be mixed with the lubricant for thickening. For such purposes they recommend the use of a high grade steam refined cylinder stock having a viscosity of about 150 seconds Saybolt Universal at 210 degrees Fahr., and a com-



Courtesy of Westinghouse Electric Elevator Co.

Fig. 7—The Westinghouse worm reduction geared elevator machine. Note the completeness with which the operating mechanisms are housed.

paratively low pour test to assure of easy starting at low temperatures without excessive power consumption. All, however, are agreed that when a new machine is put in service the oil should be changed after a run-in period.

The question of compounding with a fixed oil is interesting and a point that should be given equal consideration. Quite as many reputable engineers maintain that to make a worm gear lubricant which will embody the above characteristics, a certain amount of fixed oil such as acidless tallow or prime lard oil must be compounded with the basic mineral oil. Usually around five percent will serve the purpose; the mineral base should be a cylinder stock.

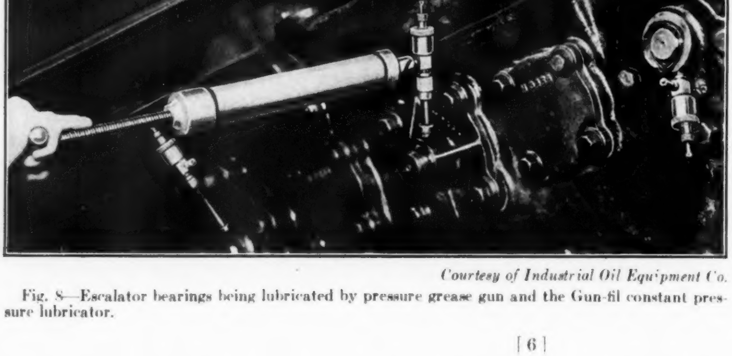
Others in turn have advocated the use of castor oil in compound. Castor oil would result in the desired flatter viscosity curve, free fatty acids would be absent, and the body or viscosity of the resultant compound would be such as to admirably meet pressure conditions. The pour test, on the other hand, is not lowered to any extent. Also, to attain a perfect mixture between castor oil and a mineral oil, with any extensive percentage of the former, is extremely difficult without the use of a third component. Even then such a mixture cannot be depended upon. Another important point is the fact that the greater percentage of so-called castor oils on the market today are not the pure product but imitations, such as aluminum soaps or blown cottonseed oil, masquerading under the name of castor.

Assuming pure castor oil were used, in all probability, notwithstanding that a seemingly complete mixture might be started with, agitation of the lubricant, its continual draining down the casing walls, and the fact that the worm dips in but part of the entire oil in the well, would tend to cause separation. Once started, it can be seen that the worm might continually be carrying less and less of the heavy component oil and more and more of the light, till ultimately the latter would be doing practically all the work.

Oil Level Important

The level at which the lubricant should be carried in the worm gear case is also important. Normally this should not be higher than the center of the worm shaft and where possible only the teeth should dip into the oil. With some oils, this is all that is necessary. Thus the only oil to reach the gear teeth is carried around by the worm. In modern construction it is customary to control the height of oil in the gear case by the installation of an external over-flow in the base. The gear, running at relatively high speed, throws any excess oil to the side of the casing where it runs down, either back to the reservoir, or to lubricate the gear shaft bearings, which in some installations are fitted with ring or chain oilers as well. The popular idea of running the worm fully submerged in oil is being gradually discarded. The action of the worm is similar to that of a screw pump, hence the resultant high pressure to which the oil is subjected would tend to cause excessive leakage along the shaft. To guard

Fig. 9—A... in contr... Figures 8 a... turn sh... work in th... of a yea... the necessit... sitive lu...



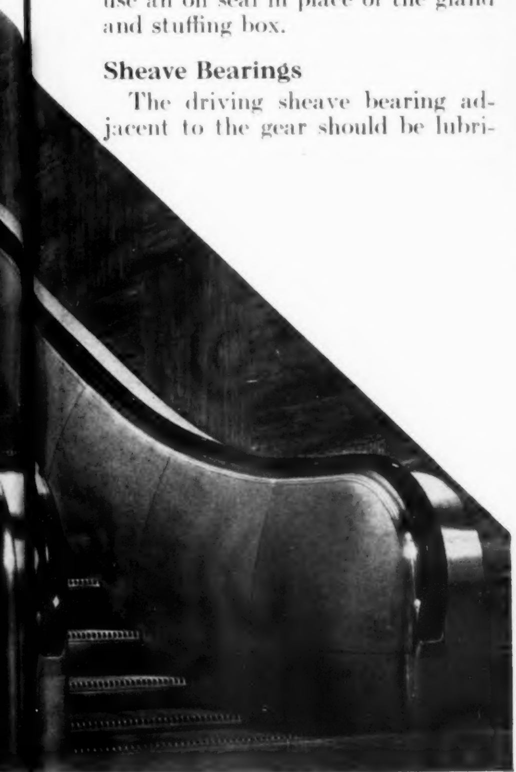
Courtesy of Industrial Oil Equipment Co.

Fig. 8—Escalator bearings being lubricated by pressure grease gun and the Gun-fil constant pressure lubricator.

against this, a grease cup is installed on the stuffing box in many installations. Thus a seal of heavy lubricant is obtained and at the same time the shaft is properly lubricated. For such purposes a relatively hard grease is recommended. Normal good practice in the absence of grease lubrication allows for a very slow rate of oil leakage from the rear stuffing box of the worm shaft, to insure sufficient lubrication of the latter. Another idea is to use an oil seal in place of the gland and stuffing box.

Sheave Bearings

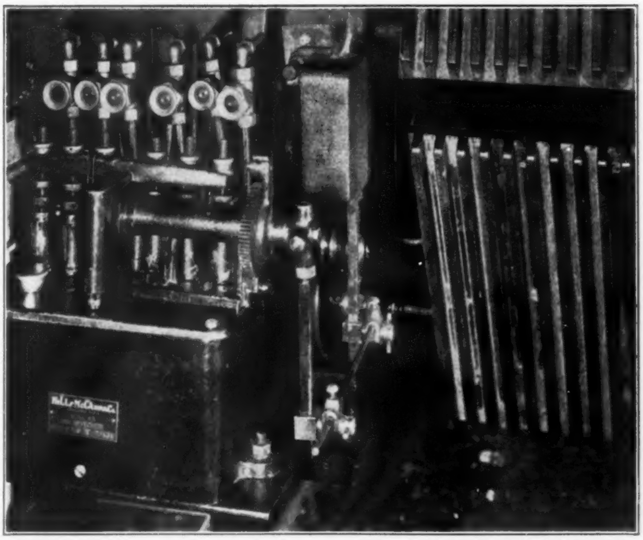
The driving sheave bearing adjacent to the gear should be lubri-



Courtesy of Westinghouse Electric Elevator Co.

—A in contrasts—the modern electric stairway and a flight of stairs. S a turn show some of the operating mechanisms. These do a lot of the of a year—a fact we little realize from surface appearance—hence essit sitive lubrication.

cated with a product capable of carrying the prevailing loads. This shaft is common to the main gear shaft and is subject to heavy pressures; hence the frequent requirement of a heavier bodied lubricant than other sheave bearings. On the other hand, the efficiency of the entire machine should never be jeopardized in an effort to use one lubricant throughout. If the gear lubricant is such as to be unsuitable for these bearings, a separate oil



Courtesy of Hills-McCanna Co.

Fig. 10—Showing the facility with which the automatic force feed lubricator can be installed, and the method of drive through an attachment to the escalator tread driving mechanism. Six feeds are shown. One of the features of any such lubricator, however, is the possibility of changing the number of feeds according to the operating conditions.

such as a 500 seconds or 750 seconds viscosity engine oil should be used.

Car and Counterweight Guide Rails

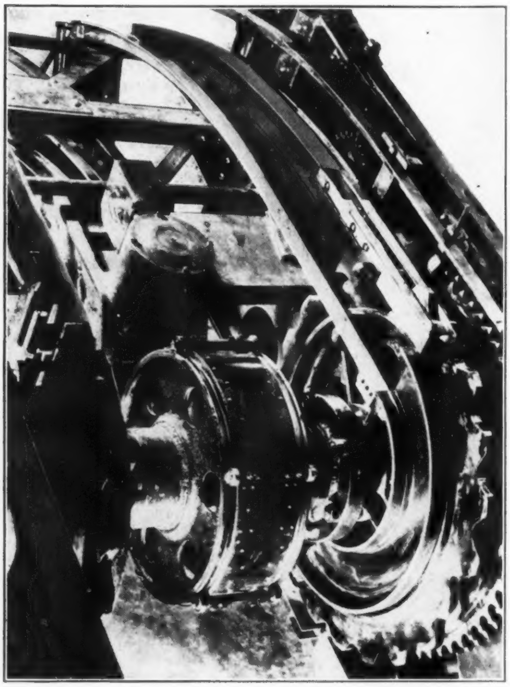
Lubrication of these elements has always been a serious problem; in consequence, a wide variety of devices have been developed for this purpose, designed to use lubricants varying all the way from light oil to extremely hard grease, yet the problem has never been satisfactorily solved. Some would like to get away from direct lubrication and to use graphite or roller type shoes which will not require lubrication of the rail. Too much graphite or any other lubricant must not be used, however, otherwise it may prevent the safety jaws from gripping the rail.

The most serious objection to using any type of lubricant in an elevator shaft is the fire hazard, hence the tendency to do away with combustible materials around the cars

Other points such as brake parts, governor, etc., can either be lubricated by hand or sight feed oil cups, using the same oil as on the motor bearings. Certain installations include grease cups for this purpose, in which event a good medium bodied compression grease will be found very satisfactory. Safety devices of the roller wedge block type, etc., while normally inoperative, should be regularly inspected and lubricated so as to insure prompt and efficient operation if required to function.

Wire Ropes and Cables

The earlier developments of the hoisting elevator wherein ropes or chains were used to raise the cage instead of rods for pushing purposes involved hempen ropes or heavy chain links. Neither required any appreciable lubrication. As the wire drawing industry



Courtesy of Westinghouse Electric Elevato Co.

Fig. 11—The guides and operating mechanisms at the top of a Westinghouse escalator. The modern escalator or electric stairway is deceptive as to the amount of machinery required for its operation. Furthermore, the fact that it must run continuously often for 12 hours at a time places a severe load upon many of its parts, thereby requiring most careful lubrication.

lubricated both in the course of its manufacture by saturation of the hemp core, and oftentimes later in service by periodic renewal of the surface lubricant.

Active operation of a rope, in which the hemp core has been treated with a lubricating compound, will tend to cause this compound to ooze out and assure that the metallic strands will have a sufficient coating to prevent entry of moisture or dust. As a rule, passenger elevator machinery is so housed that exposure to moisture, the weather, steam, corrosive vapors, etc., will not be excessive. On the other hand, freight elevators, or elevators in service in industrial plants where such detrimental features are most prevalent, are subject to longer periods of inaction. The lubricant for such service should possess certain distinctive properties:

(a) It should not harden, nor contain any residual matter that is of a non-lubricating character.

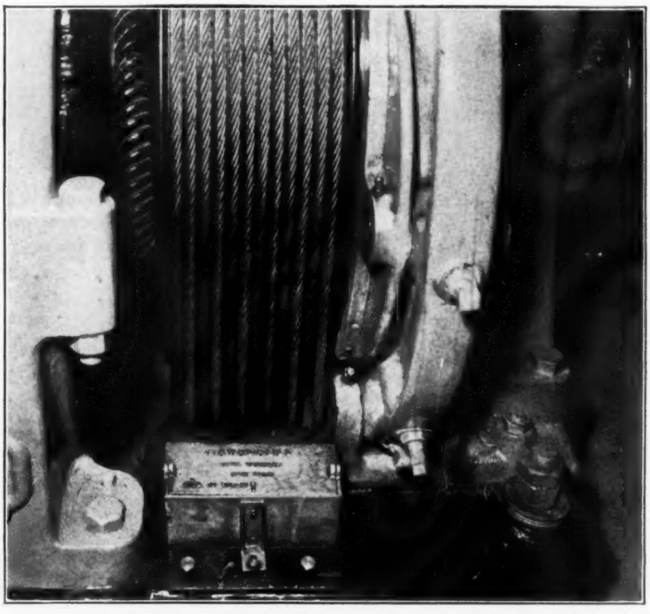
(b) It should have a high penetrative property, in order that it can work its way between individual metallic strands, to lubricate the interior of the rope and prevent water or other destructive elements from coming in contact with the strands.

(c) It should be highly adhesive, to resist

progressed, however, contemporary with the Brooklyn Bridge wire ropes were dependably applied to the earlier types of electric elevators. They were soon proved to be quite as dependable as chains, which were subject to fatigue, being stronger for a given weight per foot of length, and furthermore were as noiseless as the hempen variety.

Wire rope, however, introduced a real problem in elevator maintenance, i.e., the problem of strand protection against rusting or corrosion. It was soon proved that straight mineral residual lubricants could meet these requirements most satisfactorily. They proved to be adhesive to metal, resistant to wear, ductile and capable of maintaining a high coefficient of friction between the ropes and hoisting drums. This latter was soon found to be most important for if ropes slipped accurate levelling off at floors became impossible. Excessive slip was even dangerous.

So the modern elevator cable is

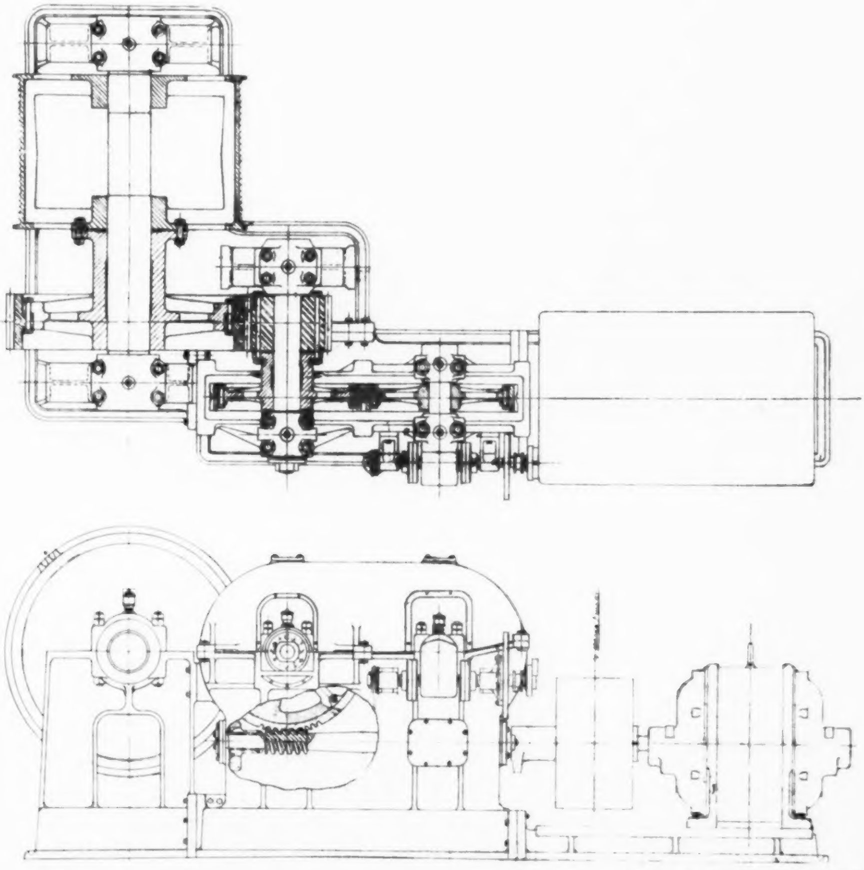


Courtesy of Sava Co.

Fig. 12—Elevator cables also require lubrication in service. Opinions differ, however, as to the type of lubricant to use. In many cases a specially prepared wire rope lubricant of comparatively heavy body is preferred. When it is desirable to use automatic means of application as pictured above such as the Savacable oiler, a low viscosity oil is practicable. The light color and transparency of such an oil when properly refined to adhere and inhibit rusting are definite points in its favor.

drip or any tendency to flow off under abnormal temperatures.

The method of application is important. In the handling of heavier lubricants, the best procedure is to heat before application, using a split box or special lubricant container through which the rope is allowed to run. Thus a light film is applied, waste is decreased and the entire surface is properly and evenly covered, yet not so heavily as to interfere with inspection.



Courtesy of The Gurney Elevator Co.

Fig. 13 An interesting line drawing of a Gurney tandem worm and helical herringbone gear reduction drum type elevator machine. This device has a lifting capacity of 25,000 pounds. Bearings are of sleeve type babbitted, hence either a medium viscosity machine oil or a plastic grease can be used for their lubrication according to the lubricating equipment desired. Housing of the worm gears permits usage of a conventional type of worm gear lubricant such as a medium-heavy steam cylinder oil. As the other gears are only guarded a heavy, straight mineral gear lubricant has been found most protective, economical and resistant to dripping or being thrown off.

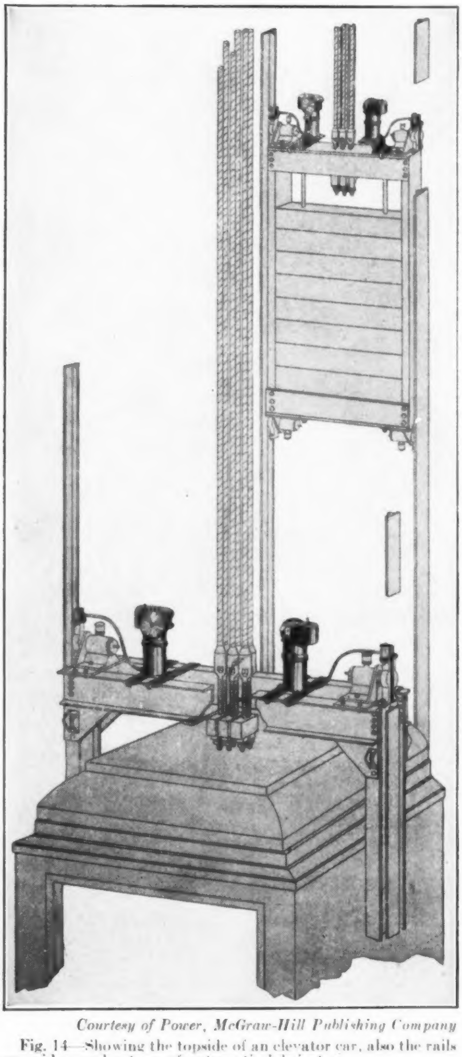
Wherever the elevator mechanism room above the hoistways may be crowded, certain of the machines may have to be staggered in their arrangement, with the secondary sheaves offset so that the ropes in passage from the driving sheaves run on an angle. This is also necessary whenever the traction sheave diameter is less than half the width of the car. Then the secondary sheave must be offset to lead the rope down to the counterweight. Under such conditions a certain amount of slippage may occur due to loss of traction at the driving sheave. This can be overcome in some cases by using a heavier lubricant of the same characteristics as above.

To attain maximum traction and insure as far as possible against slippage, some consider it best practice in sheave construction today to cut the base of each groove somewhat smaller in diameter than the rope, then to bevel the straight sides of the groove to about an 80 degree angle. This gives two points of contact between rope and groove, and is claimed by the proponents to increase the traction.

THE ELECTRIC ESCALATOR

The escalator, or traveling stairway, so familiar to patrons of the modern department

store, followed the perfection of the electric elevator as a means of expediting one or more floor handling of passengers in a continuous stream without the necessity for attendants or the time lost in operating doors. The modern



Courtesy of Power, McGraw-Hill Publishing Company

Fig. 14—Showing the topside of an elevator car, also the rails or guides, and a type of automatic lubricator.

escalator must of necessity be a slow speed machine, for it must permit of passengers stepping on or off without the possibility of falling.

The electric escalator may well be likened to an inclined conveyor equipped with stair treads which form themselves automatically as they come into working position on the rising or descending approach.

The mechanisms essential to this operation have lent themselves readily to automatic lubrication. The mechanical force feed lubricator designed for measured oil delivery to certain of the working elements has proved especially adaptable. Likewise the pressure grease gun used in connection with suitable fittings designed for retention of a certain amount of pressure and the exclusion of contaminating foreign matter. The driving mechanism is of the worm gear type, requiring lubrication of the same nature as the geared traction machine.

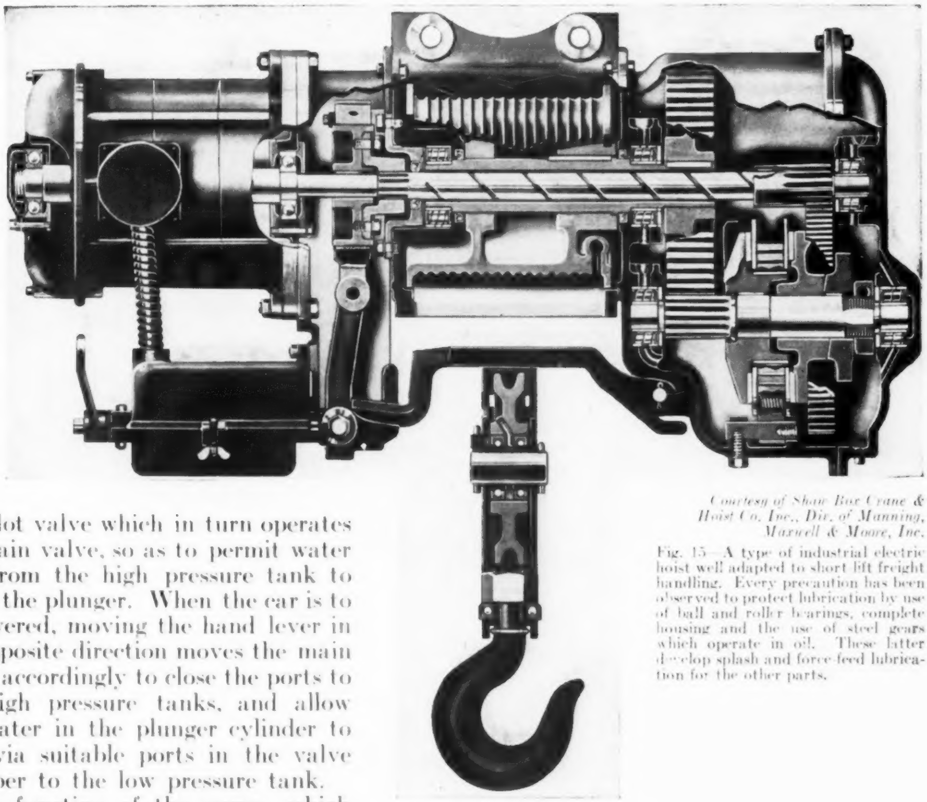
FEATURES OF HYDRAULIC ELEVATORS

The hydraulic plunger elevator was the basic development involving the principles of hydraulics. In this type the car is lifted by means of a steel tube plunger of from 5 to 10 inches in diameter, actuated by water pressure of from 75 to 200 lbs., per square inch. The high speed machine will have a plunger of less diameter and will operate under higher water pressures than the low-rise freight elevator. In either type, however, the plunger operates in a pipe cylinder set in the ground within a steel casing. In general, it must be several feet longer than the distance through which the car is intended to travel, and the containing cylinder must be proportionately deep.

The pipe cylinder is supplied with water, as necessary, at an inlet just below the stuffing box, through an operating valve usually of the balanced-piston type, fitted with leather cup valves. In the high speed elevator, a pilot valve, operated from the car preferably by lever control, via an endless rope, actuates the main valve by such gearing arrangements as general construction may require. Limit valves in the supply and exhaust lines are operated automatically by ropes when the car reaches the upper or lower limits.

Lifting of the car is aided by a descending counterweight, ropes which connect this to the car, passing over fixed sheaves at the top of the hoistway. Therefore, in descent the car must exert sufficient pressure to force the water out of the cylinder.

To provide the water supply requires the installation of two tanks, one high pressure, and one low pressure, suitably piped to the pumping set and control valves. Where enclosed, both tanks are filled with about 30 per cent of air, which acts as somewhat of a cushion, being supplied as desired from the water pump by admittance at the suction side. Air also aids in maintaining constant pressure. The high pressure tank carries the operating pressure of the system. When the car is to be raised suitable moving of the hand lever therein, and consequently the control rope, actuates



Courtesy of Shaw Box Crane & Hoist Co. Inc., Div. of Manning, Maxwell & Moore, Inc.

Fig. 15—A type of industrial electric hoist well adapted to short lift freight handling. Every precaution has been observed to protect lubrication by use of ball and roller bearings, complete housing and the use of steel gears which operate in oil. These latter develop splash and force feed lubrication for the other parts.

the pilot valve which in turn operates the main valve, so as to permit water flow from the high pressure tank to below the plunger. When the car is to be lowered, moving the hand lever in the opposite direction moves the main valve accordingly to close the ports to the high pressure tanks, and allow the water in the plunger cylinder to pass via suitable ports in the valve chamber to the low pressure tank.

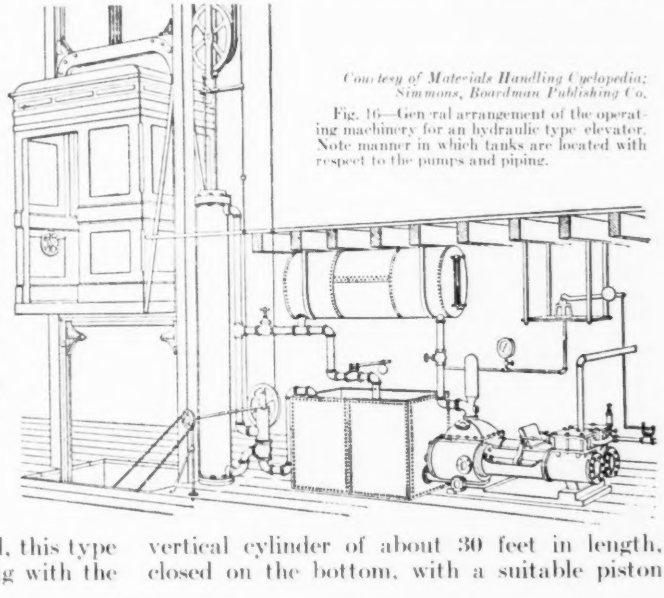
The function of the pump, which may be steam or electrically driven, is to transfer this water from the low pressure to the high pressure tank where it is again available for use when required. Thus we have an endless sequence of water flow. Loss is practically negligible, so on an average but little make-up water is necessary and complete change of water in the system and cleaning of tanks is essential only about twice a year. In such a system the pumping set should be provided with automatic starting and stopping regulators which act when the high pressure tank reaches its minimum or maximum.

Where the roof level is sufficiently high to give the required hydrostatic pressure for operation open tanks may be located at this point. Conversely, installations for low lift may even discard tanks altogether, using city water direct, if it is under adequate and dependable pressure.

The Hydraulic Cylinder Rope-Geared Elevator

As elevator engineering progressed, this type of device came into popularity along with the hydraulic plunger machine. It was found to be especially adaptable where there was more shaft space than floor area available, and where excavation would have been difficult.

A popular type of such an elevator employs a vertical cylinder of about 30 feet in length, closed on the bottom, with a suitable piston



Courtesy of Materials Handling Cyclopedia; Simmons, Boardman Publishing Co.

Fig. 16—General arrangement of the operating machinery for an hydraulic type elevator. Note manner in which tanks are located with respect to the pumps and piping.

attached to two piston rods usually, which pass through stuffing boxes in the top. These rods are fixed by yoke and frame to suitable traveling sheaves installed overhead, their arrangement depending on the desired car travel with respect to the piston travel, and the lifting capacity required. The principle involved is essentially that of the block and fall. To raise the car, water is admitted by a suitable valve arrangement to the cylinder at the top, thereby forcing the piston down. To lower the car, this water is allowed to escape, its rate of flow being controlled by a main valve which is operated by a pilot valve manipulated from the car by a lever device. Automatic top and bottom limit stops are provided to shut off the water when the limits are reached, and relief valves are installed in the exhaust to allow for the passage of the water from the bottom to the top of the cylinder, if the stop is too sudden.

Other variations of the hydraulic rope-geared elevator are the horizontal cylinder pulling and pushing types. Their operation is similar to the vertical type, except that an independent counterweight is used in place of the movable sheaves, piston and rod. In the pushing type the fixed sheaves are supported on the back head of the cylinder and the piston connected to the traveling sheave so as to push them apart.

Some designs also provided for pressures of from 700 to 800 pounds per square inch, to enable development of high speeds and reduction in the size of piping and cylinders.

Hydraulic Elevator Lubrication

Comparatively few mechanisms require lubrication in an hydraulic elevator installation. In general, one will only have to consider the plunger (or piston rod), pumping system, sheave bearings, and control valve. The plunger is usually coated periodically with a good grade of straight mineral lubricant having a viscosity of around 1000 seconds at 210 degrees Fahr., (Saybolt) to insure free sliding through the cylinder stuffing box.

Pump lubrication in turn depends upon the type of unit and the motive power. In lubricating steam driven pumps, the selection of steam cylinder oils is of importance; as saturated steam is generally employed such an oil should usually be a compounded product, of a high grade steam refined cylinder stock with 6 per cent to 8 per cent of fixed (animal) oil added to insure proper emulsification and sticking of the lubricant to the cylinder, etc., in the presence of moisture. External parts, such as rocker arms, etc., can be lubricated with a good grade of engine oil, of about 300 seconds to 500 seconds (Saybolt) viscosity at 100 degrees Fahr., applied either by hand or by sight feed oil cups.

Plungers or piston rods on the water sides of such pumps require no lubrication other than they naturally receive from the water itself, which may be treated periodically with an emulsifying compound.

This procedure is necessary to cause precipitation of any fine grit and impurities in suspension which would cause excessive wear on packing valves, etc. It also enables the water to contain in an emulsified state a certain amount of lubricant in order to prevent deterioration of the leather cup control valves, and to keep them in a soft pliable condition. Soluble oil will usually meet the requirements of such service. It is generally added to the system in controlled amounts about every two weeks.

The condition of sheave bearings can usually be maintained in a satisfactory manner if inspection and maintenance of lubricating equipment is carried out at regular intervals, according to their design. Where this requires oil a medium heavy machine oil of from 300 to 500 seconds viscosity will suffice.

Other parts requiring lubrication in a hydraulic system are the controlling mechanism for the operating valves, and the guides for the counterweight and car. The former, if of rack and pinion type, should be preferably lubricated with a good grade of gear compound, with a viscosity of about 200 seconds Saybolt at 210 degrees Fahr. The latter can be lubricated in the same manner as the corresponding parts on an electric elevator.

Printed in U. S. A. by
Edgar C. Ruwe Co., Inc.
72 Washington St., N. Y. C.